YOUNG SCIENTIST ACTIVITY BOOK

CLASS - XII

Sample Pages

EDUHEAL FOUNDATION
• LEARNING FOR LIFE •

DISCOVER ● INVENT ● EXPERIMENT ● EXPLORE

CLASS - XII

SYLLABUS GUIDELINES

PHYSICS

Electrostatics

Electric Charges; Conservation of charge, Coulomb's law-force between two point charges, forces between multiple charges; superposition principle and continuous charge distribution. Electric field, electric field due to a point charge, electric field lines; electric dipole, electric field due to a dipole; torque on a dipole in uniform electric field. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside). Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor. Van de Graaff generator.

Current Electricity

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel. Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge. Potentiometer - principle and its applications to measure potential difference and for comparing emf of two cells; measurement of internal resistance of a cell.

Magnetic Effects of Current and Magnetism

Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Force on a moving charge in uniform magnetic and electric fields. Cyclotron. Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferro - magnetic substances, with examples. Electromagnets and factors affecting their strengths. Permanent magnets.

Electromagnetic Induction and Alternating Currents

Electromagnetic induction; Faraday's law, induced emf and current; Lenz's Law, Eddy currents. Self and mutual inductance. Need for displacement current. Alternating currents, peak and rms value of alternating current/ voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits, wattless current.

AC generator and transformer.

Electromagnetic waves

Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves. Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, Xrays, gamma rays) including elementary facts about their uses.

Optics

Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applica-

tions, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact. Refraction and dispersion of light through a prism. Scattering of light - blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia, presbyopia and astigmatism) using lenses. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Wave optics: wave front and Huygens' principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygens' principle. Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarisation, plane polarised light; Brewster's law, uses of plane polarised light and Polaroids.

Dual Nature of Matter and Radiation

Dual nature of radiation. Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation-particle nature of light. Matter waves-wave nature of particles, de Broglie relation. Davisson-Germer experiment.

Atoms & Nuclei

Alpha-particle scattering experiment; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivityalpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission and fusion.

Electronic Devices

Semiconductors; semiconductor diode – I-V characteristics in forward and reverse bias, diode as a rectifier; I-V characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates (OR, AND, NOT, NAND and NOR). Transistor as a switch.

Communication Systems

Elements of a communication system (block diagram only); bandwidth of signals speech, TV and digital data); bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation. Need for modulation. Production and detection of an amplitude-modulated wave.

CHEMISTRY

Solid State

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties.

Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, elevation of B.P., depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass.

Electrochemistry

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells; corrosion.

Chemical Kinetics

Rate of a reaction (average and instantaneous), factors affecting rates of reaction; concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical

treatment)

Surface Chemistry

Adsorption – physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis : homogenous and heterogeneous, activity and selectivity: enzyme catalysis; colloidal state: distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsion – types of emulsions.

General Principles and Processes of Isolation of Elements

Principles and methods of extraction - concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and Iron.

p-Block Elements

Group 15 elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen - preparation, properties and uses; compounds of nitrogen: preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only); Phosphorous-allotropic forms; compounds .of phosphorous: preparation and properties of phosphine, halides (PCl3, PCl5) and oxoacids (elementary idea only)

Group 16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen: preparation, properties and uses; simple oxides; Ozone. Sulphur - allotropic forms; compounds of sulphur: preparation, properties and uses of sulphur dioxide; sulphuric acid: industrial process of manufacture, properties and uses, oxoacids of sulphur (structures only).

Group 17 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens: preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structures only).

Group 18 elements: General introduction, electronic configuration. Occurrence, trends in physical and chemical properties, uses.

d and f Block Elements

General introduction ,electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour catalytic property, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of K2Cr2O7 and KMnO4.

Lanthanoids - electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction.

Actinoids - Electronic configuration, oxidation states.

Coordination Compounds

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. bonding; isomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

Haloalkanes and Haloarenes

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions.

Haloarenes: Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only) Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses, some important compounds - methanol and ethanol. **Phenols :** Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophillic substitution reactions, uses of phenols.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, and mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Organic compounds containing Nitrogen

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and Isocyanides - will be mentioned at relevant places in context.

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Biomolecules

Carbohydrates - Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance.

Proteins - Elementary idea of a - amino acids, peptide bond, polypeptides proteins, primary structure, econdary structure, tertiary structure and quaternary structure (qualitative idea only), denaturation of proteins; enzymes.

Vitamins -Classification and functions. **Nucleic Acids:** DNA & RNA .

Polymers

Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters

BIOLOGY

SEXUAL REPRODUCTION

Pollination and fertilization in flowering plants. Development of seeds and fruits. Human reproduction: reproductive system in male and female, menstrual cycle. Production of gametes, fertilization, implantation, ,embryo development, pregnancy and parturation. Reproductive health - birth control, contraception and sexually transmitted diseases.

Genetics and evolution

Mendelian inheritance. Chromosome theory of inheritance, deviations from Mendelian ratio (gene interaction-Incomplete dominance, co-dominance, complementary genes, multiple alleles). Sex determination in human beings: XX, XY. Linkage and crossing over. Inheritance pattern of haemophilia and blood groups in human beings. DNA: replication, transcription, translation. Gene expression and regulation. Genome and Human Genome Project. DNA fingerprinting. Evolution: Theories and evidences.

BIOLOGY AND HUMAN WELFARE

Animal husbandry. Basic concepts of immunology, vaccines. Pathogens, Parasites. Plant breeding, tissue culture, food production. Microbes in household food processing, industrial production, sewage treatment and energy generation. Cancer and AIDS. Adolescence and drug/alcohol abuse.

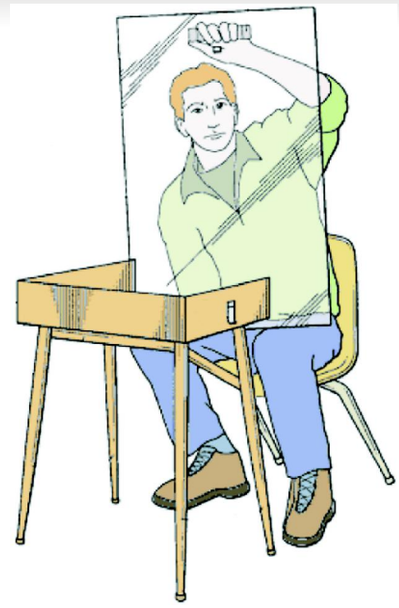
BIOTECHNOLOGY AND ITS APPLICATIONS

Recombinant DNA technology. Applications in Health, Agriculture and Industry Genetically modified (GM) organisms; biosafety issues. Insulin and Bt cotton

ECOLOGY & ENVIRONMENT

Ecosystems: components, types and energy flow. Species, population and community. Ecological adaptations. Centres of diversity and conservation of biodiversity, National parks and sanctuaries. Environmental issues.

Glass Stopping Bullet



At first glance, bullet-resistant glass looks identical to an ordinary pane of glass, but that's where the similarities end. An ordinary piece of glass shatters when struck by a single bullet. Bullet resistant glass is designed to withstand one or several rounds of bullets depending on the thickness of the glass and the weapon being fired at it. So, what gives bullet-resistant glass the ability to stop bullets?

Different manufacturers make different variations of bullet-resistant glass, but it is basically made by layering a **polycarbonate** material between pieces of ordinary glass in a process called **lamination**. This process creates a glass-like material that is thicker than normal glass. Polycarbonate is a tough transparent plastic — Bullet-resistant glass is between 7 millimeters and 75 millimeters in thickness. A bullet fired at a sheet of bullet-resistant glass will pierce the outside layer of the glass, but the layered polycarbonate-glass material is able to absorb the bullet's energy and stop it before it exits the final layer.

The ability of bullet-resistant glass to stop a bullet is determined by the thickness of the glass. A rifle bullet will collide with the glass with a lot more force than a bullet from a handgun, so a thicker piece of bullet-resistant glass would be needed to stop a rifle bullet as opposed to a handgun bullet.

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Do You Know ?

Q. Why does water, which is colourless, become white when it freezes?

Ans.: In liquid state the arrangement of molecules in water is such that light can pass through them and it looks colourless. When water freezes and become ice, the molecular arrangement is rigid and there is no room for light to pass through, making it white.

Q. When both iron and steel are made of raw iron, why does iron get attracted to magnets and not steel?

Ans.: Alloy steel or special steel, popularly called stainless steel, is non-magnetic because it contains 18 percent chromium, 8 percent nickel and 74 percent steel. There are several types of stainless steel, which contain chromium ranging from 4 to 22 per cent and nickel from 0 to 26 per cent. Since the alloy contains non-ferrous compounds upto 26 per cent, stainless steel does not get attracted to magnet.

Q. What is fibre glass? How does it differ from ordinary glass?

Ans.: Glass is a supercooled liquid which forms a non-crystalline solid. It is a hard, brittle amorphous material which is usually transparent or translucent and resistant to chemical attack. On the other hand, glass fibre is glass melted and drawn into fibres. The fibres are then impregnated with resin to produce a material that is both strong and corrosion resistant.

Q. What is the difference between drug and medicine?

Ans.: Medicine is used to treat a disease or illness, while drugs are used in dying or chemical operations and is a terms used for narcotics like heroin, morphine and cocaine. Drugs are also used for manufacturing medicines.

Q. Why does the temperature of boiling liquid remain constant even when heating continues?

Ans.: As a liquid reaches its boiling point, the liquid starts converting into vapours. The conversion requires some work done, which in turn requires some energy. Thus, the energy required to do the work is supplied by the source of heat of vaporisation of the liquid. Thus, even when the liquid is receiving heat energy constantly from the source, the temperature of the liquid does not rise.

Q. Why does fog appear only at dawn and not at dusk?

Ans.: Fog is nothing but a cloud on earth. During the day time, due to the heat of the sun, the water on the surface of the exam evaporates and is carried up with the hot air which is lighter than the cold air. Therefore there is no fog at dusk. But during cold nights, the vapour does not rise and remains suspended over the surface on the earth, which is seen as fog at dawn.

Q. Why are medicines administered in doses and not all at one shot?

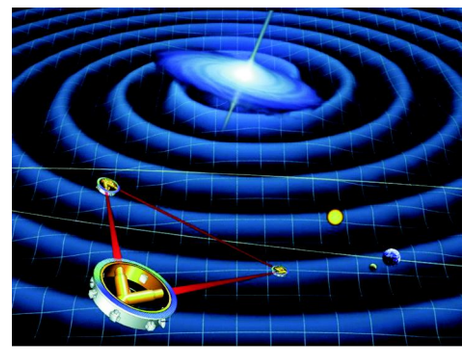
Ans.: Drugs that we consume contain some toxic material. When it is consumed in small quantities it does not affect the body as the body has something called maximum toxic level (MTL). When the quantity of the drug is small the toxic level in the body is less and it starts acting against the disease.

With time, the toxic level starts falling and at one stage the toxic level lowers to zero. It is at this stage that we are supposed to take the next dose. But on consuming a high dosage of the drug, the toxic level of the body crosses the MTL and the drug consumed can no longer act against the disease in the body. Hence, doctors prescribes drugs is regulated doses.

Squeeze me, Stretch me

At this very moment, disturbances from outer space are stretching and squeezing you. Knowing exactly when and by how much you are squashed or stretched will enable humans to learn much more about our universe, perhaps even telling us more about the Big Bang, or shedding light on the mystical "dark matter" that is posited to exist in huge quantities throughout the universe.

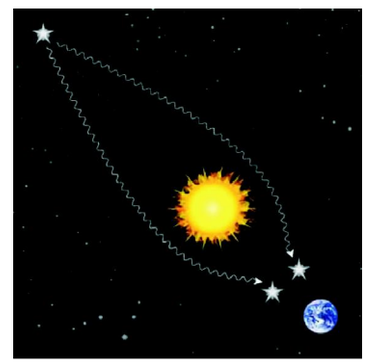
Making waves



This stretching and squeezing is due to *gravity waves*, also known as *gravitational radiation*. Every heavy object that is changing speed or direction makes gravity waves. These waves move through space in the same way that light does - even at the same speed. But, unlike light waves, if a gravity wave passes through your neighbourhood, it will (temporarily!) change the distances between everything - even the distance between your navel and your spine. But this isn't a miracle slimming event, nor will anyone notice you looking plumper than usual. These waves, and the amount they change the distances between objects, are very tiny. A big wave will change the dis-

tance between two objects by one-billionth the distance from one side of an atom to the other. This change is equivalent to a change in the distance between the Earth and its nearest star (four light-years away) by a tenth of a millimetre.

Gravity waves are among the consequences of Einstein's General Theory of Relativity. It basically says that the curvature of spacetime is equal to the matter in it. If you take a large flat rubber sheet (and call it spacetime), and put a bowling ball (matter) in the middle of it, the rubber sheet becomes curved. If you put different matter on the sheet, it curves differently. On the rubber sheet, before you put the ball on it, the shortest distance between two points is a straight line. When you put something heavy in the middle, you can no longer go in a straight line staying on the sheet, and the shortest distance is called a **geodesic**.



Light always takes the shortest path, so it always travels along geodesics. Since geodesics aren't always straight, light doesn't always travel in straight lines. If a star is hiding behind our sun, it is possible that we could still see it, because light travelling from it to us can be bent around the sun. Durring a total solar eclipse, the sun vanished behind the moon, and the physicists could see the stars that were normally hidden by the sun's glow. Their measurements showed that at least two of the stars they could see were in fact the same star, with light taking different paths, bending around our sun, to get here. Einstein and his theory became instantly famous.

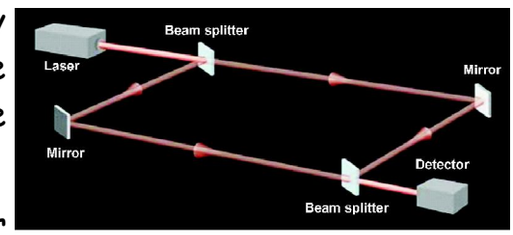
If you are finding it hard to imagine how there can be more than one "shortest way" between two points, here is an analogy. If you want to get to New Zealand from England by the quickest way,

you can actually leave England pointing any direction you want. This is because the Earth is curved, and because New Zealand is on the opposite side of it.

Playing gravity detective

The tiny size of gravity waves has made them very difficult to find. Einstein first predicted in 1918 that heavy objects, such as two stars moving around each other, would give off gravity waves. Since then, many people have tried to find them - to do so would be more evidence for the theory of relativity, and would give us a new, powerful way of looking at the universe.

The best way to detect gravity waves would be to measure one of those tiny changes in distance they cause. This could be done by getting something large, with ends exactly parallel, and then constantly measure the distance between the ends. If the distance changes, you've detected a gravity wave.



But it's not that simple. If a car goes past on the road beside your laboratory, it will shake the ground and your detector, causing a change in distance far greater than anything caused by the wave you are trying to find. Then there's also the problem of the atoms in your detector. They jiggle around, as all atoms do, all the time. Again, this jiggling has a much greater effect than a gravity wave.

There is hope, however. There are currently several projects around the world that will start working within a few years. For example, there is LISA (Laser Interferometer Space Antenna), a space-based system that uses lasers and mirrors. Another is LIGO (Laser Interferometer Gravitational wave Observatory), which

uses the same type of system. Both these systems split a laser beam into two parts, send them a long distance at right angles to each other, and then reflect them back. When the beams are joined again, the resulting interference pattern will show whether there is any distance change. If these detectors overcome the difficulties faced during earlier experiments, we can expect to have a whole new way of looking at the stars.

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There is also one-way bullet-resistant glass available, which has one side able to stop bullets, while the other side allows bullets to pass through it unaffected. This gives a person being shot at the ability to shoot back. This type of bullet-resistant glass is made by laminating a brittle sheet of material with a flexible material.

Imagine a car equipped with this one-way bullet-resistant glass. If a person outside the car shoots a bullet into the window, the bullet would strike the brittle side first. This brittle material would shatter around the point of impact and absorb some of the energy over a large area. The flexible material then absorbs the remaining energy of the bullet, stopping the bullet. A bullet fired from inside the same car would easily pass through the glass because the bullet's force is concentrated on a small area, which causes the material to flex. This causes the brittle material to break outwards, allowing the bullet to pierce the flexible material and strike its target.

Nationwide Interactive Science Olympiad, 2007

Sample Paper

PHYSICS & CHEMISTRY

Sections in Mental Ability and Physics & Chemistry is compulsory for all students Biology and Computer Science 45 optional based upon the streams which student has selected.

1. The rear side of a truck is open and a box of mass 20 kg is placed on the truck 4 m away from the open end. The truck starts from rest with an acceleration of 2 ms^{-2} on a straight rod. If coefficient of friction between box and truck is 0.15 and g = 10 ms^{-2}, the box will fall off the truck when it is at a distance from the starting point equal to
(a) 4 m (b) 8 m (c) 16 m (d) 32 m.

2. A rope of length l passes over a frictionless pulley whose axis is horizontal. Two boys hang from the ends of the rope at the same distance l/2 from the pulley. The boys begins to move up at the same time. The first boy moves up with a speed v relative to the string and the second boy moves with a speed $2v$. The time taken by the first and the second boy in meeting each other is .....Given: The boys are of equal masses and the rope is massless.

(a) $\frac{l}{v}$ (b) $\frac{l}{2v}$ (c) $\frac{l}{3v}$ (d) $\frac{l}{4v}$

3. Velocity of a body moving in simple harmonic motion, is

(a) $\omega^2\sqrt{a^2+y^2}$ (b) $\omega\sqrt{a^2-y^2}$ (c) $\omega\sqrt{a^2+y^2}$ (d) $\omega^2\sqrt{a^2-y^2}$.

4. When a glass plate is introduced in between two charged bodies, the force between them

(a) increases (b) decreases
(c) remains same (d) becomes zero.

5. What is the change in the P.E. of a body raised through a height h in water. The density of the body is d and that of water is d_0 where $d > d_0$. The volume of the body is V.
(a) the potential energy increases by $hVdg$
(b) the potential energy increases by $V(d - d_0)gh$
(c) the potential energy increases by hVg
(d) the potential energy remains unchanged.

6. X-rays are diffracted by crystals because
(a) they are intense (b) they are mono-energetic
(c) they are penetrating
(d) their wavelength is of the same order as the lattice spacing.

7. A particle of mass M is moving in a horizontal circle of radius R with uniform speed v. When it moves from one point to a diametrically opposite point, its
(a) momentum changes by 2 Mv
(b) kinetic energy changes by $Mv^2/4$
(c) kinetic energy changes by Mv^2
(d) momentum does not change.

8. Which of the following statements about NaCl structure is not true
(a) Cl^- ions are in fcc arrangement
(b) Na^+ ions has coordination number 4
(c) Cl^- ions has coordination number 4
(d) each unit cell contains 4NaCl molecules.

9. Nitrogen and oxygen exist as diatomic but their cogeners are P_4 and S_8 respectively. This is due to
(a) phosphorus and sulphur are solids
(b) phosphorus and sulphur polymerise as soon as they are formed

(c) phosphorus and sulphur catenate due to the existence of *d* -orbitals and form strainless structures
(d) none of these.

10. The 19th electron of chromium has which of the following set of quantum numbers

	n	l	m	s
(a)	3	0	0	$\frac{1}{2}$
(b)	3	2	–2	$\frac{1}{2}$
(c)	4	0	0	$\frac{1}{2}$
(d)	4	1	–1	$\frac{1}{2}$

11. Rutherford's alpha particle scattering experiment eventually led to the conclusion
(a) mass and energy are related
(b) electron occupy space around nucleus
(c) neutrons are buried deep in nucleus
(d) the point of impact with the matter can be preciously determined.

12. pK_a values of two acids *A* and *B* are 4 and 5. The strengths of these two acids are related as
(a) the strengths of the two acid cannot be compared
(b) acid *B* is 10 times stronger than acid *A*
(c) acid *A* is 10 times stronger than acid *B*
(d) strength of acid *A* : strength of acid *B* = 4 : 5.

13. Which statement is correct about the alcohols?
(a) Solubility of aliphatic alcohols decreases in water with mass due to the hydrophobic nature of alkyl chain.
(b) Solubility increases with branching in alkyl group chain
(c) boiling points decreases with branching in chain
(d) all of these

14. Lucas reagent is
(a) concentrated HCl + $ZnCl_2$ (b) dilute HCl + $ZnCl_2$
(c) H_2DO_4 + $ZnCl_2$ (d) concentrated HCl + Zn

15. Isoelectric point of an aminoacid is the pH at which the amino acid molecules
(a) migrate to the anode (b) migrate to the cathode
(c) would not migrate to the anode or to the cathode, and exist as neutral dipolar ions
(d) move alternately to the anode and the cathode.

MENTAL ABILITY

16. Pointing to a man in the photograph, a woman said, "His brother's father is the only son of my grand father'. How is the woman related to the man in the photograph?
(a) Mother (b) Aunt (c) Sister (d) Daughter

17. Standing on a platform, Amit told Sunita that Aligarh was more than ten kms but less than fifteen kms from there. Sunita knew that it was more than twelve but less than fourteen ms from there. If both of them were correct, which of the following could be the distance of Aligarh from the platform?
(a) 11 kms (b) 12 kms (c) 13 kms (d) 14 kms

18. Five plants are grown in a row. Mango plant is on the left of Neem plant, Orange plant is on the right of Peepal plant, which is on the right of Neem plant. Leechi plant is on the left of the mango plant. Which plant is in the centre?
(a) Mango (b) Neem (c) Orange (d) Peepal

19. A man walks 30 m towards south. He turns to his right and walks 30 m. Then turning to his left and walks 20 m. Again turning to his left and walks 30m. How far is he from the starting point?
(a) 30 m (b) 20 m
(c) 80 m (d) none of these

20. If SHARP is coded as 58034 and PUSH is coded as 4658, then how RUSH is coded?
(a) 3568 (b) 3658 (c) 3685 (d) 3583

21. The Memory Buffer Register (MBR)

(a) is a hardware memory device which denotes the location of the current instruction being executed

(b) is a group of electrical circuits (hardware), that performs the intent of instructions fetched from memory.

(c) contains the address of the memory location that is to be read from or stored into

(d) contains a copy of the designated memory location specified by the MAR after a "read" or the new contents of the memory prior to a "write".

22. Match the following.

Column I	**Column II**
(A) In C++, array indices star from 0 and are up till size 1.	1. True
(B) C++ requires the function definition before it is used anywhere in the program	2. False
(C) C++ makes the function prototyping essential.	
(D) C++ provides four storage class modifiers : auto, register, static, and extern.	

(a) A-II, B-I, C-I, D-I (b) A-I, B-I, C-I, D-I

(c) A-I, B-I, C-II, D-II (d) A-II, B-I, C-II, D-1

23. Examine the following statements on hard disk present in a computer.

1. Hard disk stores the computer's operating system and provides space for user's data.
2. A hard disk has a floating magnetic read/write head moving across the surface of a disk coated with magnetically sensitive material.
3. It contains two or more vertically stacked platters each with its own read/write head.
4. There cannot be more than one hard disk in a computer.

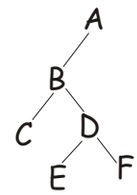
5. Hard disks are enclosed in a sealed container as the read/write head 'floats' just above the magnetic discs, at a distance 3000 times less than the width of human hair. If the head encounters an obstacle such as dust or a smoke particle a head crash would occur.

Which of the above statements are true.

(a) 1, 2 and 3 only (b) 1, 2, 4 and 5 only
(c) All except 4 (d) 1 and 2 only

24. Assume that X has been declared as an integer variable in C++ program. What will happen if the program encounters non-integer data while reading the value of X?
Then.....error occurs.
Fill in the blank using the choices given below .
(a) Syntax (b) Type (c) Execution (d) Logical

25. It is required to create six directories viz. A, B, C, D, E, and F. These directories should follow the hierarchy shown in the following tree.



The directory A should be created in the root directory of drive C. Is the given sequence of MS-DOS commands correct which would yield the desired result?

C > MDA ↵; C > CD A ↵; C > MD B ↵; C > D B ↵; C > MD C ↵;
C > MD D ↵ ; C > CD D ↵ ; C > MD E ↵; C > MD F ↵

(a) Yes (b) No
(c) Can't say (d) Information incomplete

BIOLOGY

26. A naturalist studying competitive interactions between flower-visiting animals in a meadow observes that hummingbirds always